

**WHAT IS CLAIMED IS:**

1           1.       A catheter for treating a vascular occlusion comprising:  
2                    an elongated shaft defined by a proximal section and a distal section  
3                    wherein the shaft is formed with at least one lumen extending from the proximal  
4                    section to the distal section of the shaft;  
5                    at least one hinged spreading member formed at the distal section of the  
6                    shaft wherein the spreading member is defined by a distal most end that moves  
7                    away from the longitudinal axis of the shaft to disrupt a vascular occlusion; and  
8                    an actuating assembly positioned along the elongated shaft to move the  
9                    distal most end of the spreading member in response to an actuation force.

1           2.       The catheter as recited in claim 1, wherein at least one hinged spreading  
2                    member includes a relatively interior portion formed with a cam follower.

1           3.       The catheter as recited in claim 2, wherein the actuating assembly includes  
2                    an actuation element defined by a distal end and a cam formed at the distal end  
3                    for communication with the cam follower formed in at least one spreading  
4                    member to urge the spreading member in a substantially lateral direction.

1           4.       The catheter as recited in claim 3, wherein the cam is configured as a  
2                    central hub that slidably contacts the cam follower formed on the interior portion  
3                    of at least one hinged spreading member when the cam is moved in a relatively  
4                    proximal direction to move the distal most end of the spreading member in a  
5                    substantially lateral direction.

1           5.       The catheter as recited in claim 3, wherein the cam is formed with a cam  
2           edge that slidably contacts the cam follower formed on the interior portion of at  
3           least one hinged spreading member when the cam is moved in a relatively distal  
4           direction to move the distal most end of the spreading member in a substantially  
5           lateral direction.

1           6.       The catheter as recited in claim 3, wherein the distal section of the shaft  
2           is formed with a co-linear bearing surface.

1           7.       The catheter as recited in claim 6, wherein the cam is configured for  
2           slidable movement along the co-linear bearing surface and the cam follower of  
3           a single hinged spreading member.

1           8.       The catheter as recited in claim 1, wherein the distal section of the  
2           elongated shaft contains a nosecone.

1           9.       The catheter as recited in claim 1, wherein the distal section of the  
2           elongated shaft contains a hub defined by an external surface.

1           10.      The catheter as recited in claim 9, further comprising a collar section fitted  
2           around the external surface of the hub.

1 11. The catheter as recited in claim 10, wherein at least two hinged spreading  
2 members are joined to the collar section as a unitary body.

1 12. The catheter as recited in claim 1, wherein the hinged spreading member  
2 is defined by a substantially curved end.

1 13. The catheter as recited in claim 1, wherein the hinged spreading member  
2 is defined by a substantially tapered end.

1 14. The catheter as recited in claim 1, wherein the hinged spreading member  
2 is defined by a substantially pointed end.

1 15. An intravascular tissue expanding catheter comprising:  
2 a catheter shaft defined by a distal end and a longitudinal axis having at  
3 least one conduit extending along the longitudinal axis of the catheter shaft;  
4 a housing formed at the distal end of the catheter shaft wherein the  
5 housing includes at least one hinged deflecting member defined by a distal most  
6 tip that moves in a substantially lateral direction away from the longitudinal axis  
7 of the shaft to expand vascular tissue; and  
8 an actuation assembly positioned along the catheter shaft to move the  
9 distal most tip of at least one hinged deflecting member away from the  
10 longitudinal axis of the shaft.

1           16.     The intravascular catheter as recited in claim 15, wherein the shaft is  
2           formed of braided material and an inner coil shaft component.

1           17.     The intravascular catheter as recited in claim 15, wherein the housing is  
2           formed of deformable material and wherein the actuation assembly includes an  
3           expandable balloon formed at the distal end of the catheter shaft positioned within  
4           the housing and an inflation conduit formed along the longitudinal axis of the  
5           catheter shaft.

1           18.     The intravascular catheter as recited in claim 17, wherein the expandable  
2           balloon expands to spread open at least one deflecting member so that the distal  
3           most tip of the deflecting member moves in a substantially lateral direction away  
4           from the longitudinal axis of the catheter shaft.

1           19.     The intravascular catheter as recited in claim 15, wherein the deflecting  
2           member includes an integrally formed hinge.

1           20.     The intravascular catheter as recited in claim 15, wherein the deflecting  
2           member includes a hinge that is separately formed and connected to the spreading  
3           member.

1           21.     The intravascular catheter as recited in claim 15, wherein the deflecting  
2           member includes a plurality of hinges.

1           22.    The intravascular catheter as recited in claim 15, wherein at least one  
2           deflecting member is formed with an internal cam follower.

1           23.    The intravascular catheter as recited in claim 22, wherein the actuation  
2           assembly includes a cam positioned within the housing for slidable movement  
3           along the cam follower of at least one deflecting member to move the distal most  
4           tip of the deflecting member in a substantially lateral direction.

1           24.    The intravascular catheter as recited in claim 23, wherein the actuation  
2           assembly includes an actuation conduit formed along the catheter shaft and a push  
3           tube positioned relatively proximal to the cam follower within the actuation  
4           conduit.

1           25.    The intravascular catheter as recited in claim 23, wherein the actuation  
2           assembly includes an actuation conduit formed along the catheter shaft and a  
3           rotational tube positioned relatively proximal to the cam follower within the  
4           actuation conduit.

1           26.    The intravascular catheter as recited in claim 23, wherein the actuation  
2           assembly includes an actuation conduit formed along the catheter shaft and a  
3           pulling element positioned relatively proximal to the cam follower within the  
4           actuation conduit.

1           27.     The intravascular catheter as recited in claim 15, wherein the actuation  
2           assembly includes a pulling element connected to at least one deflecting member.

1           28.     The intravascular catheter as recited in claim 27, wherein the deflecting  
2           member is connected to the housing with a hinge pin to form a hinge that  
3           supports rotation of at least one deflecting member when the pulling element is  
4           pulled in a relatively proximal direction.

1           29.     The intravascular catheter as recited in claim 27, wherein the deflecting  
2           member and the housing are integrally formed of nitinol to provide a rivetless  
3           hinged section that supports deflection of at least one deflecting member when  
4           the pulling element is pulled in a relatively proximal direction.

1           30.     The intravascular catheter as recited in claim 27, wherein the pulling  
2           element is formed of nitinol.

1           31.     The intravascular catheter as recited in claim 15, wherein the catheter  
2           shaft is defined by an external surface and a guidewire conduit is formed within  
3           the external surface of shaft.

1           32.     The intravascular catheter as recited in claim 31, wherein the guidewire  
2           conduit is formed offset from the longitudinal axis of the shaft.

1           33.     The intravascular catheter as recited in claim 15, wherein the catheter  
2 shaft is defined by an external surface and a guidewire conduit is formed along  
3 the external surface of shaft.

1           34.     An intravascular catheter comprising:  
2                 a catheter body formed with a distal section and at least one conduit;  
3                 at least one tissue expanding member connected to the distal section of the  
4 catheter body wherein the expanding member includes a relatively proximal  
5 portion and a relatively distal portion so that the distal portion is configured to  
6 spread apart relative to the proximal portion of the expanding member; and  
7                 an actuation assembly positioned within the catheter body in  
8 communication with the tissue expanding member to spread apart the distal  
9 portion of the expanding member.

1           35.     The intravascular catheter as recited in claim 34, wherein the distal section  
2 includes a relatively fixed extension and wherein the relatively proximal portion  
3 of the tissue expanding member is connected to the fixed extension with a hinge  
4 pin to permit the relatively distal portion of the tissue spreading member to move  
5 away from the fixed extension.

1           36.     The intravascular catheter as recited in claim 35, wherein the actuation  
2 assembly includes an actuation wire connected to the relatively proximal portion  
3 of the tissue expanding member with an actuation wire attachment .

1           37.     The intravascular catheter as recited in claim 36, wherein the distal section  
2           is formed with a guidewire lumen.

1           38.     The intravascular catheter as recited in claim 37, wherein the hinge pin is  
2           positioned in between the guidewire lumen and the actuation wire attachment  
3           within the distal section of the catheter body.

1           39.     The intravascular catheter as recited in claim 37, wherein the guidewire  
2           lumen is positioned in between the hinge pin and the actuation wire attachment  
3           within the distal section of the catheter body.

1           40.     The intravascular catheter as recited in claim 39, further comprising a  
2           guidewire tube extension defined by an outer surface positioned along at least a  
3           portion of the fixed extension for enclosing a guidewire.

1           41.     The intravascular catheter as recited in claim 40, wherein the tissue  
2           expanding member is formed with a surface that is complementary to the outer  
3           surface of the guidewire tube extension.



1           42.    A catheter shaft comprising:  
2                    an outer catheter shaft defined by a longitudinal shaft lumen;  
3                    an inner coiled body defined by a longitudinal coiled lumen that is  
4           positioned within the longitudinal shaft lumen for column load reinforcement of  
5           the outer shaft; and  
6                    a movable pulling element slidably positioned within the longitudinal  
7           coiled lumen for relative movement of the pulling element with respect to the  
8           inner coiled body.

1           43.    The catheter shaft as recited in claim 42, wherein the outer shaft is braid  
2           reinforced.

1           44.    The catheter shaft as recited in claim 42, wherein the inner coiled body is  
2           closely wound.

1           45.    The catheter shaft as recited in claim 42, wherein the outer catheter shaft  
2           is substantially defined by an outer diameter ranging from approximately 0.025  
3           to 0.080 inches.

1           46.    The catheter shaft as recited in claim 42, wherein a proximal portion of  
2           the inner coiled body is a hypotube.

1           47.    A catheter shaft comprising:  
2                   a reinforced outer catheter shaft formed with an outer shaft lumen;  
3                   an inner shaft positioned within the outer shaft lumen that is formed with  
4                   an actuation lumen and at least one inner shaft lumen;  
5                   a column load reinforcement coil formed with a coil lumen that is  
6                   positioned within the actuation lumen; and  
7                   an actuation wire slidably positioned within the coil lumen to provide  
8                   relative movement of the wire within the coil.

1           48.    The catheter shaft as recited in claim 47, wherein at least one inner shaft  
2                   lumen is configured for placement of a guidewire.

1           49.    The catheter shaft as recited in claim 48, further comprising a guidewire  
2                   positioned within the inner shaft lumen.

1           50.    The catheter shaft as recited in claim 49, wherein the inner shaft lumen  
2                   and the actuation lumen are formed in a non-concentric configuration.  
3

1           51.    A reinforced catheter body comprising:  
2                   a braid reinforced catheter shaft formed with a longitudinal catheter shaft  
3                   lumen;  
4                   an actuation conduit formed with a longitudinal actuation conduit lumen  
5                   and a guidewire conduit both positioned within the longitudinal lumen of the  
6                   catheter shaft;

7 a coiled support tube formed with a coiled tube lumen positioned within  
8 the actuation conduit lumen for column load reinforcement of actuation conduit;  
9 and  
10 a pulling element positioned within the coiled tube lumen for relative  
11 slidable movement within the support tube.

1 52. An intravascular catheter for expanding tissue comprising:

2 a catheter body defined by a distal section that is formed with an outer  
3 reinforced shaft coaxially formed about an inner coiled body for column load  
4 reinforcement of the catheter body wherein the inner coiled body is formed with  
5 an actuation conduit;

6 a tissue expanding member defined by an interior cam follower connected  
7 to the distal section of the catheter body wherein the expanding member includes  
8 a relatively proximal portion and a relatively distal portion so that the distal  
9 portion is configured to expand relative to the proximal portion of the expanding  
10 member; and

11 an actuation element positioned within the actuation conduit and wherein  
12 the actuation element is formed with a cam for communication with the interior  
13 cam follower of the tissue expanding member to expand the distal portion of the  
14 expanding member when actuated.

1           53.    An intravascular catheter for expanding tissue comprising:  
2                   a catheter body defined by a distal section that is formed with an outer  
3                   reinforced shaft coaxially formed about an inner coiled body for column load  
4                   reinforcement of the catheter body wherein the inner coiled body is formed with  
5                   an actuation conduit;  
6                   a tissue expanding member connected to the distal section of the catheter  
7                   body wherein the expanding member includes a relatively proximal portion and  
8                   a relatively distal portion so that the distal portion is configured to expand relative  
9                   to the proximal portion of the expanding member; and  
10                  an actuation element positioned within the actuation conduit to expand the  
11                  distal portion of the expanding member when actuated.

1           54.    The intravascular catheter as recited in claim 53, wherein the distal section  
2                   of the catheter body includes a relatively fixed extension and wherein the  
3                   relatively proximal portion of the tissue expanding member is connected to the  
4                   fixed extension with a hinge pin to permit the relatively distal portion of the tissue  
5                   spreading member to move away from the fixed extension.

1           55.    The intravascular catheter as recited in claim 54, wherein the actuation  
2                   element is a pull wire connected to the relatively proximal portion of the tissue  
3                   expanding member with an actuation wire attachment .

1           56.    A catheter for treating a vascular occlusion comprising:  
2                    an elongated shaft having a proximal section and a distal section, a  
3           longitudinal axis and at least one lumen extending therein;  
4                    a tissue displacing assembly having at least one tissue displacing member  
5           in the distal section which is configured to rotate about one end thereof away  
6           from a longitudinal axis to displace tissue of a vascular occlusion; and  
7                    an actuating assembly positioned at least in part within the elongated shaft  
8           to rotate an end of the tissue expanding member and configured to be operable  
9           from the proximal section of the elongated shaft.